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ABSTRACT

This monograph is a synthesis of research findings of the National Institute of Child Health and Human Development research program concerning how children learn to read, why some children and adults have difficulties learning to read, and effective ways to help children learn to read. The review covered studies performed over the last 33 years at 41 research sites throughout the world with more than 34,500 children and adults. Evidence and findings are outlined for each of these three areas. Among nine conclusions concerning how children learn to read is that reading is not a natural process and learning to read is a lengthy process that begins substantially before formal schooling. The 15 conclusions for why some individuals have difficulties learning to read are grouped into those concerned with prevalence, developmental course, and psychometric characteristics and those concerned with environmental, experiential, and individual difference factors. In presenting conclusions about reading instruction, the seven conclusions focus on which teaching approaches and strategies are most beneficial for which children at which stages of reading development. (DB)

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Keys to Successful Learning:

A National Summit on Research in Learning Disabilities

The NICHD Research Program in Reading Development, Reading Disorders and Reading Instruction

A Summary of Research Findings

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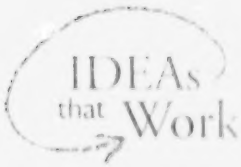

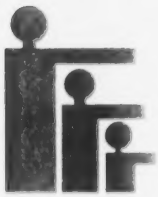

Keys to Successful Learning is an ongoing collaboration sponsored by the National Center for Learning Disabilities in partnership with the Office of Special Education Programs (U.S. Department of Education) and the National Institute of Child Health & Human Development (National Institutes of Health).

The purpose of this initiative is to translate research and policy on learning disabilities into high standards for learning and achievement in the classroom, and to take action at the local, state and federal levels to ensure that all students, including those with learning disabilities, are afforded the highest quality education.

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The NICHD Research Program in Reading Development, Reading Disorders and Reading Instruction:

A Summary of Research Findings

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Background and Purpose

Learning to read is critical to a child's (and an adult's) well-being. The child and adult who cannot read at a comfortable level experience significant difficulties mastering many types of academic content, are at substantial risk for failure in school, and are frequently unable to reach their potential in the vocational and occupational arena. Unfortunately, the rate of reading failure and illiteracy are unacceptably high in the United States. Over 40 percent of fourth grade students performed below basic levels on the National Assessment of Educational Progress (NAEP) in both 1994 and 1998. Over 10% of fourth grade children could not even participate in the NAEP due to severe reading difficulties. Moreover, converging evidence from longitudinal, population-based data indicate that at least 17 percent to 20 percent of children have a significant reading disability. A real crisis revealed in these statistics is the disproportionate representation of children who are poor, racial minorities, and non-native speakers of English. However, it is also noteworthy that large numbers of school-age children from all social classes, races and ethnic groups have significant difficulties learning to read. Because reading is so critical to success in our society, reading failure constitutes not only an educational problem but also rises to the level of a major public health problem.

Since 1965, the National Institute of Child Health and Human Development (NICHD), within the National Institutes of Health (NIH), has conducted and continuously supported research efforts to address three fundamental questions that must be answered if reading failure is to be understood and addressed successfully. These three questions are: (1) How do children learn to read? What are the critical environmental, experiential, cognitive, linguistic, genetic, neurobiological, and instructional conditions that foster reading development? (2) Why do some children and adults have difficulties learning to read? What specific cognitive, linguistic, environmental, and instructional factors impede the development of accurate and fluent reading skills, and what are the most significant risk factors that predispose youngsters to reading failure? (3) How can we help most children learn to read? Specifically, for which children are which teaching approaches and strategies most beneficial at which stages of reading development? To answer these three questions, the NICHD has developed a research network consisting of 41 research sites in North America, Europe, and Asia to study reading development, reading disorders and other learning disabilities, and reading instruction. During the past 33 years, NICHD scientists have studied the reading development of 34,501 children and adults. Many studies have been devoted to understanding normal reading development, and 21,860 good readers have participated in these investigations, many for as long as 12 years. Significant efforts have also been deployed to understand why many children do not learn to read. Within this context, 12,641 individuals with reading difficulties have been studied, many for as long as 12 years. In addition, since 1985, the NICHD has initiated studies designed to develop early identification methods that can recognize those children during kindergarten and first-grade who are most at-risk for reading failure. These studies have provided the foundation for several longitudinal prevention and

early intervention projects now underway at 11 sites in the U.S. and Canada. Since 1985, 7,669 children (including 1,423 good readers) have participated in these reading prevention, early intervention, and remediation studies, and 3,600 children are currently enrolled in longitudinal intervention trials in Texas, Washington, DC, Georgia, Massachusetts, New York, Florida, Colorado, North Carolina, and the state of Washington. These studies involve the participation of 1,012 classroom teachers, working in 266 schools and 985 classrooms.

The purpose of this report is to synthesize the major converging findings that have been obtained by NICHD scientists for each of the three questions that have guided the reading research program. This synthesis is derived from an analysis of over 2,500 publications generated by NICHD scientists since 1965.

Converging Evidence and Findings Relevant to Each Major Research Question

How Do Children Learn to Read?

Evidence and Findings

- Reading is not a natural process. In contrast to oral language development, reading does not emerge naturally from interactions with parents and other adults, even in print-rich environments. For most children, reading requires systematic and explicit instruction, although the degree of explicitness, directiveness, intensity and duration of instruction requires developing specific reading components that would vary across children.

- Learning to read is a relatively lengthy process that begins very early in children's development and substantially before they enter formal schooling. There is a strong and critical relationship between the amount and quality of early language and literacy interactions and experiences and the acquisition of the linguistic skills necessary for reading. Moreover, frequent language and literacy interactions from birth onward serve to aid in the development of oral vocabulary, an awareness of print and literacy concepts, and an understanding of the goals of reading. Exposure to oral reading and language play (e.g., rhyming) has been found to serve a foundational role in the development of phonemic awareness.

- Reading development requires the acquisition of phonemic awareness and other phonological processing skills. Specifically, a necessary foundational skill that beginning readers must master is that the words and syllables that they hear via oral language are composed of small units of sound, termed phonemes.

- Becoming aware of the sound structure (phonemes) within syllables and words is made difficult because unlike writing, when communicating orally, the separate sounds composing an utterance cannot be "heard" by the ear due to a process termed co-articulation. Specifically, when producing speech orally, as in saying the word cat, only one sound is heard, not three, as in c/a/t. The vocal apparatus merges the three sounds to permit rapid communication, and it is the brain, not the ear that recovers the sound segments from the acoustic bundle. In essence, to learn to read, the individual must discover that spoken words can be segmented into smaller units of sound, that letters on the page represent these sounds, and that written words have the same number and sequence of sounds heard in a spoken word.

- As noted above, the beginning reader must be able to translate print to speech. In an alphabetic language, like English, the individual letters on a page are initially abstract and meaningless optical units. These optical shapes must eventually be linked to sounds - the phonemes discussed above. In essence, the beginning reader must learn the connections between the 26 letters of the alphabet and the approximately 44 English-language phonemes. The understanding that written spellings systematically represent the phonemes of spoken words is termed "the alphabetic principle" and is absolutely necessary for the development of accurate and rapid decoding and word reading skills. The development of sound-symbol relationships is also frequently termed "phonics."

- Although the development of phoneme awareness and the alphabetic principle are necessary to learn to read, these skills, in and of themselves, are not sufficient. Specifically, in order for the novice reader to begin to devote more attention and memory capacity to the text that is being read for strong comprehension to occur, phonological and decoding skills must be applied accurately, fluently and automatically. Laborious application of decoding and word recognition skills while reading text reduces attentional and memory resources,

thus impeding reading comprehension.

- The ability to understand what has been read appears to be based on several factors. Children who comprehend well are able to activate their relevant background knowledge when reading - they can relate what has been read to their own experiences and background knowledge. Strong comprehension abilities are clearly related to oral language comprehension, which like reading comprehension is also critically dependent on the acquisition of a robust oral vocabulary. Individual differences in reading comprehension also vary with the reader's ability to actively summarize, clarify, and predict while reading and the ability to employ syntactical conventions to enhance comprehension.

- The development of phoneme awareness, the alphabetic principle, word reading accuracy and fluency, reading vocabulary, and active reading comprehension strategies are all necessary, but not sufficient in and of themselves, to produce robust reading capabilities. These reading elements or components must be exquisitely integrated via informed instruction and practice.

- Opportunities to learn to read and to practice the application of reading skills is essential to developing accuracy and fluency and a strong sight word vocabulary. In turn, reading practice serves as a major factor in the continued development of oral vocabulary, particularly as children move past the third grade.

Why Do Some Children and Adults Have Difficulties Learning to Read?

Evidence and Findings

Prevalence, Developmental Course, and Psychometric Characteristics

- NICHD population-based, epidemiological longitudinal studies indicate that at least 17 percent to 20 percent of the nation's population displays a reading disability. Thus, at least 10 million children, or 1 child in 5 will experience significant difficulties learning to read well enough to utilize reading to learn and for enjoyment. Non-NICHD prevalence studies and assessments (e.g., NAEP) place reading failure at higher levels ranging from 20 percent in some states to 59 percent in others.

- While public schools identify approximately four times as many boys as girls as reading disabled, NICHD longitudinal and epidemiological studies show that as many girls as boys have difficulties learning to read.

- Reading disabilities typically persist throughout childhood, adolescence, and adulthood. Difficulties learning to read do not reflect a transient developmental lag. NICHD longitudinal studies indicate that of children who are reading disabled in the third grade, 74 percent remain disabled at the end of high school.

Distinguishing between disabled readers with an IQ-reading achievement discrepancy and those without a discrepancy reflects an invalid practice at the beginning stages of reading. Specifically, children with and without a discrepancy do not differ in the information processing skills (phonological and orthographic coding) that are necessary for the accurate and rapid reading of single words. Likewise, genetic and neurophysiological (functional MRI) studies have not indicated differential etiologies for reading disabled children with and without discrepancies. Converging data from several NICHD sites also indicates that the presence and magnitude of IQ-reading achievement discrepancies are not related significantly to a child's response to intervention.

- Children with reading disabilities differ from one another and from other good readers along a continuous distribution, and do not aggregate together in a distinct "hump" at the tail of the distribution. Reading disabilities reflect dimensional rather than categorical individual differences.

Environmental, Experiential, and Individual Difference Factors

- Children most at-risk for reading failure are those who enter school with limited exposure to the English language and who have little prior understanding of concepts related to phonemic sensitivity, letter knowledge, print awareness, the purposes of reading, and oral language and verbal skills, including vocabulary. Children raised in poverty, youngsters with limited proficiency in English, children with speech and hearing impairments, and children from homes where the parent's or caretaker's reading levels are low are relatively predisposed to difficulties learning to read. Likewise, youngsters with sub-average intellectual capabilities frequently manifest greater difficulties in reading comprehension.

- The most frequent characteristic observed among children and adults with reading disabilities is a slow,

labored approach to decoding or "sounding-out" unknown or unfamiliar words and frequent misidentification of familiar words. Oral reading is hesitant and characterized by frequent starts and stops and multiple mispronunciations.

- One of the most powerful predictors of reading comprehension abilities is the speed and accuracy of reading single words. Likewise, one of the most powerful predictors of speed and accuracy in reading single words is the strength of phonemic awareness skill development.

- In contrast to good readers who have discovered that letters and letter patterns represent segmented units of sound (phonemes), poor readers have substantial difficulty developing this principle. As noted in the discussion of reading development, the major factor impeding the development of the alphabetic principle and thus decoding and word reading skills is a lack of facility in phonemic awareness.

- Phonemic awareness skills assessed in kindergarten, in combination with assessment of the child's ability to provide letter and number names and letter sounds, are strong predictors of difficulties learning to read. Deficits in phoneme awareness skills impact the ability to develop accurate and fluent word reading capabilities which significantly degrade comprehension of what has been read.

- In addition to being negatively affected by phonological and word level deficits, reading comprehension is impeded by, among other factors: (1) vocabulary deficits; (2) inadequate background knowledge relevant to the information presented in text; (3) lack of familiarity with semantic and syntactic structures that can be employed to predict and better understand word and grammatical relationships; (4) lack of knowledge about different writing conventions that are employed by the author to achieve different purposes via text (humor, explanation, dialogue, etc.); (5) lack of verbal reasoning ability which enables the reader to "read between the lines"; and (6) the ability to remember and/or recall verbal information.

- Motivational factors are clearly relevant to reading development and reading disorders, given that the improvement a disabled reader may make in learning to read is highly related to their willingness to persist despite difficulties. Unfortunately, little is specifically known about the exact timing and course of motivational influences in reading development.

- There is strong converging evidence for a genetic cause of some types of reading disability with deficits in phonemic awareness being the greatest hereditary factor. Family history is one of the most important risk factors, with 23 to as much as 65 percent of children who have a parent with reading disability having the same difficulties. A rate among siblings of affected persons of approximately 40 percent and among parents ranging from 27 to 49 percent provides opportunities for early identification.

- Converging evidence suggests that at least one type of reading disability can be linked to the HLA region of chromosome 6 reflecting a possible association with autoimmune disorders. Evidence obtained from twin and kindred siblings with severe deficits in reading performance support a Quantitative Trait Locus on chromosome 6. Chromosome 15 has recently been linked to individual differences in word reading skills.

- Phonemic awareness and word reading deficits can also result from a lack of oral language and literacy exposure and interactions following birth and through the preschool years. If children are not provided opportunities to listen to and interact with language in multiple contexts, their background knowledge about sounds, print concepts, and vocabulary concepts will be negatively affected. Whether or not limited oral language exposure is reflected in differences in neural development during the early years is not yet known.

- A range of neurobiological investigations employing post-mortem brain specimens, brain morphometry, functional brain imaging, and electrophysiology suggests there are differences in the temporo-parieto-occipital neural regions between some individuals with reading disability and those who are not reading-impaired. Additional studies suggest differences in the striate or extrastriate cortex, converging with a large body of literature describing anatomical lesions in posterior brain regions in acquired alexia, most prominently located in the angular gyrus.

How Can We Help Most Children Learn to Read?

Specifically, for Which Children Are Which Teaching Approaches and Strategies Most Beneficial at Which Stages of Reading Development?

Evidence and Findings

- A massive effort must be undertaken to inform parents and caretakers of the importance of providing oral language and literacy experiences from the first days of life - to engage children in playing with language through nursery rhymes, storybooks, and as they mature, early writing activities. Parents and caretakers must become intimately aware of the importance of vocabulary development and must interact verbally with their children to enhance verbal reasoning, semantic, and syntactical abilities.

- Reading out loud to children is a proven activity for developing vocabulary and language expansion characteristics, and plays an important role in developing receptive and expressive language skills. Reading out loud to children can also help to enhance children's background knowledge of new concepts that will appear in both oral and written language.

- NICHD prevention and early intervention studies continue to provide converging evidence on the importance of developing accurate and fluent word reading skills, given the significant importance of such skills in developing reading comprehension abilities.

- Prevention and early intervention studies in Tallahassee, Gainesville, Syracuse, Albany, Houston, Seattle, and Washington, DC are providing converging evidence that for those children who are at risk for reading failure, highly direct and systematic instruction to develop phoneme awareness and phonics skills, reading fluency and automaticity, and reading comprehension strategies within a literature-rich environment will be required to obtain maximum gains. It is also imperative that each of these reading components be taught within an integrated context and that ample practice in reading familiar material be afforded to enhance fluency and automaticity. Likewise, the most effective interventions provide ample opportunities to read and discuss authentic literature.

- NICHD and substantial non-NICHD research does not support the claim that the use of context is a proxy for applying decoding strategies to unknown or unfamilar words. To guess the pronunciation of words from context, the context must predict the words. But content words - the most important words for text comprehension - can be predicted only 10 to 20 percent of the time. Instead, the strategy of choice among well developing good readers is to decode letters to sound in an increasingly complete and accurate manner, which is dependent upon robust development of phonemic and phonics skills.

- Without a doubt, early identification and intervention is essential to maximizing treatment success in children who are at risk for reading failure. NICHD studies have led to the development of accurate and reliable identification procedures that are linked to prevention programs. NICHD studies have clearly demonstrated that the intensity and duration of reading interventions must increase exponentially as children get older just to achieve the same degree of improvement attainable during kindergarten and the first grade.

- One factor that impedes effective instruction with children at risk for reading failure is current teacher preparation practices. Many teachers have not had the opportunity to develop basic knowledge about the structure of the English language, reading development, and the nature of reading difficulties. Major efforts must be undertaken to ensure that colleges of education develop preparation programs to foster the necessary content and pedagogical expertise at both preservice and inservice levels.

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